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[MED 20: Pumps]

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(पहला पुनरीक्षण)

Indian Standard

PUMPS — CENTRIFUGAL SELF PRIMING — SPECIFICATION

(First Revision)

ICS 23.100.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

February 1999 Price Group 5

Pumps Sectional Committee, HMD 20

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Pumps Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

This standard was first published in 1977. In this revision the scope has been enlarged to cover both horizontal and vertical, single and multistage centrifugal self priming pumps. Illustrations have been incorporated to explain the type and working of different types of self priming pumps. The method of pump performance tests and the applicable tolerances have been referred to in IS 11346:1985 'Testing set up for agricultural pumps'. The provision for static balancing has been made for lower speed and lower impeller diameter pumps.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PUMPS — CENTRIFUGAL SELF PRIMING — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard specifies the technical requirements for horizontal/vertical, single/multi stage centrifugal self priming pumps for handling clear cold water.

1.2 Types

The various types of self priming centrifugal pumps are as follows:

a) Re-circulation in suction (*see* Fig. 1);
b) Re-circulation in delivery (*see* Fig. 2);
c) Auxiliary self priming pump with main pump (*see* Fig. 3); and
d) Self priming pump with built-in ejector (*see* Fig. 4).

1.2.1 Details of types of self priming pumps and their working principle are given in Annex A and Fig. 1 to Fig. 4.

2 REFERENCES

The Indian Standards listed below are necessary adjuncts to this standard:

IS No.	*Title*
210 : 1993	Grey iron castings (*fourth revision*)
318 : 1981	Leaded tin bronze ingots and castings (*second revision*)
1570 (Part 2/ Sec 1) : 1979	Schedule for wrought steels: Part 2 Carbon steels (unalloyed steel), Section 1 Wrought products (other than wire) with specified chemical composition and related properties (*first revision*)
5120 : 1977	Technical requirements for rotodynamic special purpose pumps (*first revision*)
6603 : 1972	Stainless steel bars and flats
9137 : 1978	Code for acceptance tests for centrifugal mixed flow and axial pumps — Class 'C'
10572 : 1983	Methods of sampling pumps
11346 : 1985	Testing set up for agricultural pumps
11723 (Part 1) :1992	Mechanical vibration — Balance quality requirements of rigid rotors: Part 1 Determination of permissible residual unbalance

3 UNITS, TERMINOLOGY AND CLASSIFICATION

3.1 For the purpose of this standard, units, terminology and classification given in IS 5120 shall apply, in addition to the following.

3.1.1 *Static Suction Lift*

It is the vertical distance between the centre line of the horizontal portion of the suction pipe line and the water level.

3.1.2 *Manometric Suction Lift*

Manometric suction lift is the vacuum gauge/suction manometer reading in metres of water column.

4 CHARACTERISTICS OF CLEAR COLD WATER

Clear cold water shall mean water having the characteristics specified below:

a) Turbidity	50 ppm silica scale, *Max*
b) Chlorides	500 ppm, *Max*
c) Total Solids	3 000 ppm, *Max*
d) *p*H	6.5 to 8.5
e) Temperature	33°C, *Max*
f) Specific gravity	1.004, *Max*
g) Hardness (drinking water)	300, *Max*

NOTES

1 If the range of *p*H value of the water pumped is between 6.5 and 7.5 and also the chloride content is less than 100 ppm, the bronze components of pump may be made of any grade of bronze. However if the range of *p*H is between 6.5 and 8.5 and the chloride content exceeds 100 ppm only zinc free bronze fitted construction or stainless steel fitted construction shall be permitted.

2 If any other characteristics of water differ from those specified in 4, the pump details will have to be agreed between the manufacturer/supplier and the user and shall be specified in the order.

5 NOMENCLATURE

5.1 Nomenclature of the parts commonly used for the different types of horizontal/vertical, single/multi stage centrifugal self priming pumps shall be as given in Fig. 2.

6 CONSTRUCTIONAL FEATURES

6.1 Materials of Construction

It is recognized that a number of materials of construction is available to meet the needs for the horizontal/vertical, single/multi stage centrifugal self priming pumps handling clear cold water. Typical material for few parts are indicated in Table 1 for the guidance of the manufacturers and users.

Table 1 Typical Materials of Main Parts of Pumpset

(*Clause* 6.1)

Sl No.	Name of the Part	Material of Construction
i)	Casing	Cast iron, Grade FG200 of IS 210
ii)	Impeller	Cast iron, Grade FG200 of IS 210 or stainless steel grade 04Cr13 or 12Cr13 or 20Cr13 of IS 6603
iii)	Casing and impeller wearing ring (if provided)	Cast iron, Grade FG200 of IS 210 or Bronze, Grade LTB2 of IS 318
iv)	Shaft	Grade 40 C8 of IS 1570 (Part 2/Sec 1)
v)	Shaft sleeve, where used	Bronze, Grade LTB2 of IS 318 or stainless steel grades 04Cr13 or 12Cr13 or 20Cr13 of IS 6603

NOTES

1 The materials listed are to be considered as only typical and indicative of minimum requirements of the material properties. The use of materials having better properties is not prejudiced by the details above provided materials for components in bearing contact with each other do not entail galling, corrosion, magnetic induction, etc.

2 To benefit from the advancement in technology of engineering plastics, thermoplastics materials such as polyphenylene oxide (PPO) poly carbonate, acetal, nylon 6 or 66, PTFE, ABS, polyester PETP, Glass filled nylon, UHMWPE (Ultra High Molecular Weight Polyethylene) etc may be used for pump parts like bearing sleeve, casing, impeller wearing ring etc. However, typical materials of the main parts are indicated below for the guidance of the manufacturer and the user.

Sl No.	Name of the Part	Material	
i)	Impeller	Glass filled polyphenylene oxide* (modified PPO), glass filled polycarbonate* properties shall be as given below.	
	Properties	*Modified Polyphenylene Oxide*	*Polycarbonate*
	Hardness (Rockwell)	M90/L106	M91
	Taber abrasion resistance, g	0 035	0 017
	Coefficient of linear, m/m°C thermal expansion	4×10^{-5}, *Max*	3×10^{-5}, *Max*
	Water absorption, 24 h at 23°C, percent	0 06, *Max*	0 29, *Max*
	Notched impact strength Izod, J/m	80, *Min*	100, *Min*
	Specific gravity	1 21 ± 0.03	1.35 ± 0.03
	Tensile strength at break, N/mm²	90, *Min*	90, *Min*
	Elongation at break, percent	4-6	3
	Mould shrinkage, percent	0 2-0.4	0 2-0.5
	Glass content, percent	20, *Min*	20, *Min*
ii)	Wearing ring	PTEE, ABS or Nylon 66	
iii)	Bearing sleeve	Polyethylene (LD/HT), Nylon 66, PTEE, polypropylene	

*Please note glass filling is extremely essential for these grades of plastics in view of abrasion resistance and better life to the end users.

6.2 Gaskets, Seals and Packings

Gaskets seals and packings used for clear cold water pumps shall conform to those specified in IS 5120.

7 DIRECTION OF ROTATION

The direction of rotation of pumpset is designated clockwise or anti- clockwise as observed when looking at the pump shaft from the driving end.

The direction of rotation shall be clearly marked either by incorporating an arrow in the casting or by a separate metal plate arrow securely fitted to the pumpset.

8 SUCTION LIMITATIONS

Suction limitations affecting the performance of pumps for clear cold water shall be the same as those specified in IS 5120.

9 INFORMATION TO BE FURNISHED BY THE PURCHASER

When inquiring or ordering pumps to this standard, the user shall furnish the following information to the supplier:

a) Total capacity required in lps,
b) Total head in metres,
c) Range of head in metres, and
d) Range of capacity in lps.

If the total head and range of head is not known, in that case the following details shall be furnished:

a) Level of static head during *KHARIF*, *RABI* and summer seasons in metres;
b) Suction pipe dia in mm;
c) Suction pipe length in m;
d) Delivery pipe dia in mm;
e) Delivery pipe length in m;
f) Pipe material;
g) Foot valve/Sluice valve/Non-return valve;
h) Number of bends in suction and delivery branch;
j) Primemover rating, if there is any [illegible] of primemover rating; and
k) If possible, sketch of installation to be furnished.

10 FACTORS AFFECTING PUMP PERFORMANCE

Factors affecting pump performance shall be the same as those specified in IS 5120.

11 DESIGN FEATURES

The pump shall have suitable features [illegible] designed to ensure satisfactory performance. In particular, the design features such as the following shall be incorporated.

a) The pump shall be provided with two bearings.
b) The pump shall be capable to operate without overloading the primemover in the specified head range. However the head range shall not be less than minimum +5 percent and minimum –15 percent of the rated duty point head up to 20 metres. Above 20 metres duty point head, the primemover shall not overload between duty point and minimum –3m head.
c) The pump shall be capable of working under static suction lift of 3 m at specified duty point or a manometric suction lift of 4.5 m.
d) The impellers may be of the enclosed or the semi-open type.
e) The inlet passages of the suction casing shall be streamlined to avoid eddies.
f) The manufacturer shall have a system of controlling dimensional accuracy within a scheme of fits and tolerance limits. The system shall help interchangeability at site of replacement of spares during repair and maintenance.

12 PUMP TEST

12.1 Sampling

The sampling and criteria of conformity shall be as specified in IS 10572.

12.2 Performance Test

The testing of the pump performance shall be in accordance with IS 11346.

12.3 Priming Test

12.3.1 *Priming Time*

Fill priming chamber with water and start the pump. The priming time shall be the total elapsed time between starting the unit and the time required to obtain a steady delivery gauge reading or full flow through the discharge pipe.

12.3.2 *Test*

The self priming pumps shall be tested to determine the priming time. The pump shall be tested at a static suction lift of 3 m. No check or foot valve shall be installed in the suction piping. The test set up shall be as shown in Fig. 5.

12.3.3 *Priming Time Conversion Factor*

If a pump is connected to a larger pipe than the nominal pipe size of the pump on the suction side, it is necessary to compute the performance for the nominal pipe size of the pump. For ease of reference, the conversion factors are given in Table 2. The method of finding the conversion factor is as explained below:

a) Select the size of the suction pipe actually used in the test.
b) Follow this line horizontally right to the vertical column under the heading size of nominal pipe.
c) The figure shown at the intersection is the conversion factor.
d) Divide the test time (in seconds) by this factor and then divide the resultant by the total vertical length of suction pipe above water level in metres. This gives the average time in seconds for air removed from a suction line of nominal size per metre of length.

13 GENERAL REQUIREMENTS

13.1 The general requirements for the pump shall be as given in IS 5120.

13.2 Pump Casing

The pump casing shall be of robust construction and shall be tested to withstand 1.5 times the shut off pressure.

13.3 Impeller

The impeller shall be dynamically balanced to grade G 6.3 of IS 11723(Part 1). However, in case the pump speed is less than 1 500 rpm and impeller dia less than 250 mm, the impeller may be statically balanced.

NOTES

1 Balancing here means the balancing of the unbalanced rotating mass in the impeller and not balancing of the axial hydraulic thrust in the impeller.

2 Plastic impeller need not be balanced.

13.4 Shaft

The shaft shall be of adequate size to transmit the required power.

14 GUARANTEE

14.1 Guarantee of Workmanship and Material

The pumps shall be guaranteed by the manufacturer against defects in material and workmanship, under normal use and service, for a period of at least 15 months from date of dispatch or 12 months from the date of commissioning whichever is less.

14.2 Guarantee of Performance

14.2.1 The pumps shall be guaranteed for their performance of:

a) the volume rate of flow and the head at the guaranteed point. The efficiency of the pumps shall be guaranteed at the declared point only.
b) Maximum self priming static suction lift at mean sea level.
c) Maximum self priming time at minimum 3 m static suction lift.

14.2.2 The guarantee shall be deemed to have been met with, if:

a) the measured values of head, volume rate of flow and efficiency are within the limits indicated in IS 11346.
b) power consumption by the pump does not exceed the recommended prime-mover rating in the specified head range.
c) the requirements of self priming time and self priming static suction lift are complied.

15 PERMISSIBLE INACCURACIES IN MEASUREMENTS

In all commercial acceptance tests for pumps a certain tolerance shall be allowed to the manufacturer on his guarantee to cover the inaccuracies of the equations for volume rate of flow, errors of observation and unavoidable errors of the instruments employed.

The permissible inaccuracy in the measurement of various quantities shall be as indicated in IS 9137.

16 PARAMETERS TO BE DECLARED BY MANUFACTURER

16.1 The following parameters shall be declared by the manufacturer:

a) Pipe size (suction and delivery),
b) Speed,
c) Duty point head and discharge rate,
d) Pump efficiency at duty point,
e) Head range for overloading requirement,
f) Recommended primemover rating,
g) Maximum permissible static suction lift, and
h) Maximum self priming time at 3 m static suction lift.

16.2 An operating and maintenance manual shall be supplied along with each pump. Such manual shall contain the following details in addition to the information mentioned in **16** and **17**.

a) Plan and cross-sectional view of the pump showing various components,
b) Spare parts list,
c) Routine maintenance and lubrication guidelines,
d) Trouble shooting tips, and
e) Warranty card.

Table 2 Priming Time Conversion Factor
(*Clause* 12.3.3)

Suction Pipe Size Used for Testing, mm	Nominal Suction Pipe Size, mm												
	10	15	20	25	32	40	50	65	80	90	100	125	150
15	1.68	-	-	-	-	-	-	-	-	-	-	-	-
20	3.23	1.92	-	-	-	-	-	-	-	-	-	-	-
25	5.1	3.0	1.57	-	-	-	-	-	-	-	-	-	-
32	9.05	5.36	2.8	1.78	-	-	-	-	-	-	-	-	-
40	12.4	7.4	3.85	2.45	1.37	-	-	-	-	-	-	-	-
50	20.2	12.0	6.25	4.0	2.23	1.62	-	-	-	-	-	-	-
65	34.6	20.6	10.7	6.8	3.82	2.78	1.72	-	-	-	-	-	-
80	48.2	28.5	14.9	9.5	5.32	3.88	2.38	1.34	-	-	-	-	-
90	-	38.4	20.0	12.8	7.15	5.2	3.2	1.87	1.34	-	-	-	-
100	-	49.0	25.5	16.2	9.1	6.62	4.06	2.37	1.71	1.27	-	-	-
125	-	95.5	39.4	25.1	14.1	10.3	6.3	3.68	2.65	1.97	1.55	-	-
150	-	-	56.5	36.0	20.2	14.7	9.05	5.3	4.0	2.82	2.22	1.44	-
200	-	-	94.5	60.8	34.0	24.7	15.3	8.9	6.4	4.75	3.74	2.44	1.68
250	-	-	-	95.2	53.6	39.0	22.9	14.0	10.05	7.46	5.90	3.8	2.65
300	-	-	-	-	75.8	55.0	33.8	19.8	14.2	10.35	8.32	5.4	3.8

17 MARKING

17.1 The self priming centrifugal pump shall be marked with the following:

a) Manufacturer's name or his recognized trade-mark;

b) Type, size and serial No. of pump;

c) Speed;

d) Head, volume rate of flow and efficiency at the specified duty point;

e) Range of head;

f) Recommended primemover rating; and

g) Arrow indicating direction of rotation.

17.2 BIS Certification Marking

The pumps may also be marked with the Standard Mark.

17.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of Conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers, may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Clause* 1.2.1)

TYPES OF SELF PRIMING CENTRIFUGAL PUMPS AND THEIR WORKING PRINCIPLE

A-1 TYPES

a) Re-circulation in suction,

b) Re-circulation in delivery,

c) Auxiliary self priming pump with main pump, and

d) Self priming pump with built-in ejectors.

A-1.1 Re-circulation in Suction

Self priming pump of this type contains water reservoir either attached to or built in the casing. Before starting the pump for the first time reservoir should be filled with water. Re-circulating port provided in the reservoir communicates with the suction side of the impeller. When the pump is started, the impeller handles the water from the re-circulating port and certain amount of air from suction side This mixture of water and air reaches the reservoir. Here the air gets separated and escapes through discharge pipe. The water enters the suction of the impeller through the re-circulating port. This operation continues until all the air has been exhausted from the suction line. The vacuum thus produced draws the water from the suction and supplies it right up to the impeller. The reservoir should remain filled with water when the pump is stopped. This is accomplished by incorporating either a valve or some form of trap between the suction line and the impeller. This type of pump is shown in Fig. 1.

A-1.2 Re-circulation in Delivery

It may be distinguished from the preceding method by the fact that the priming liquid is not returned to the suction of the pump but mixes with the air either with in the impeller itself or at its periphery. Its principal advantage therefore is that it eliminates the complexity of internal valve mechanisms. This type of pump is shown in Fig. 2.

A-1.3 Using an Auxiliary Self Priming Pump with the Main Pump

In this type an air pump is attached on the suction side of the pump whose impeller is driven by the extension of the pump shaft. The air pump runs in parallel with the water pump, exhausts the air from the suction duct and discharges it into open air (or into the discharge pipe, if it is an open line). After priming, the air pump discharges the water, generally back into the suction line. The two kinds of air pumps used commonly are side channel type and water ring type. These are shown in Fig. 3.

A-1.4 Self Priming Pump with Built-in Ejectors

Ejectors devices have been used for a considerable time to create a vacuum. They have also found application in self priming centrifugal pumps. Ejector pumps or jet pumps are distinguished by their large suction head (up to 9 m). They are less sensitive to impurities in the water than side channel pumps or peripheral pumps. This type of pumps is shown in Fig. 4.

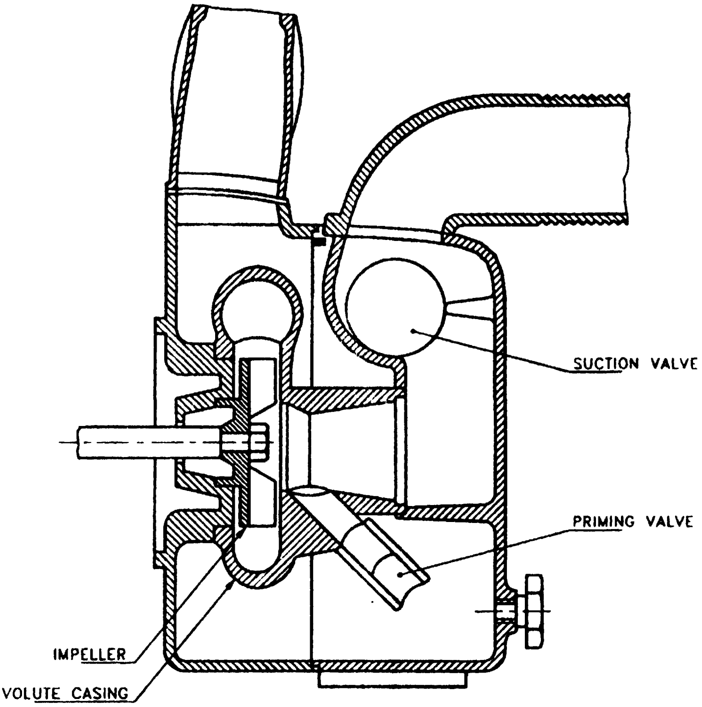


FIG. 1 SELF PRIMING PUMP RE-CIRCULATION IN SUCTION

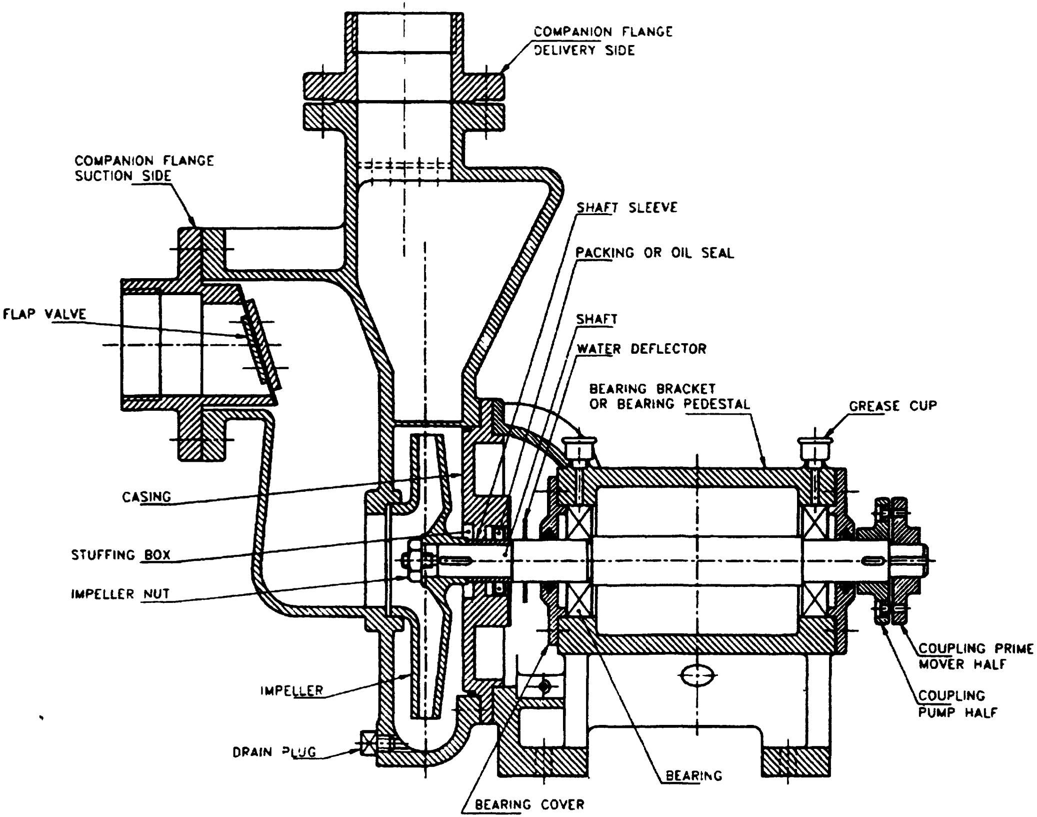
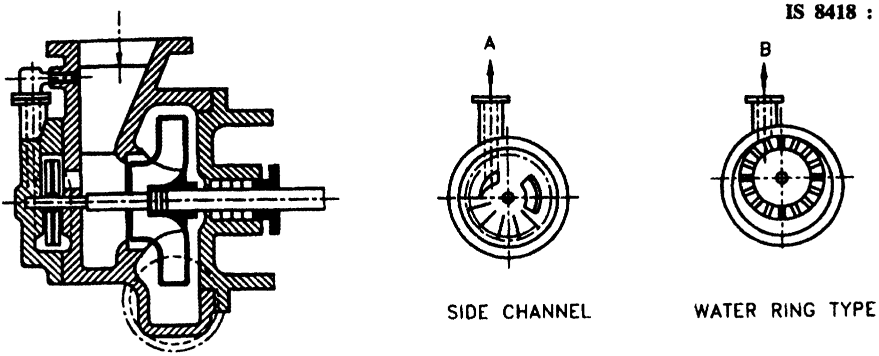


FIG. 2 SELF PRIMING PUMP RE-CIRCULATION IN DELIVERY



SIDE CHANNEL

WATER RING TYPE

FIG. 3 AUXILIARY SELF PRIMING PUMP WITH MAIN PUMP

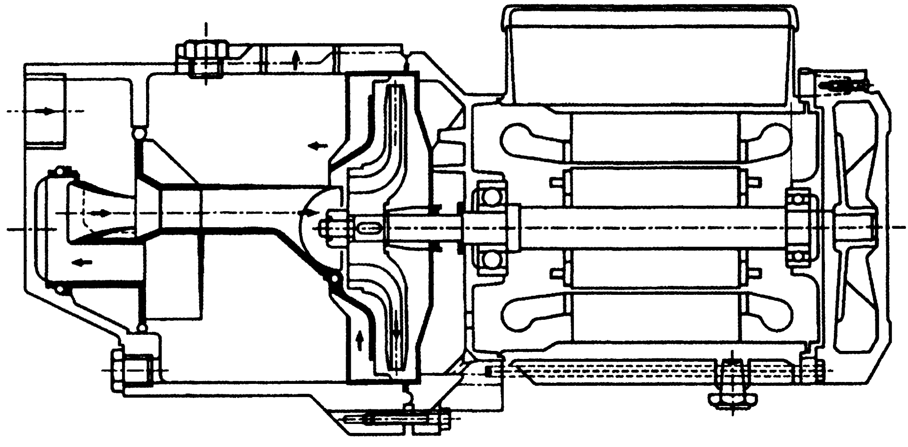


FIG. 4 SELF PRIMING PUMP WITH BUILT-IN EJECTOR

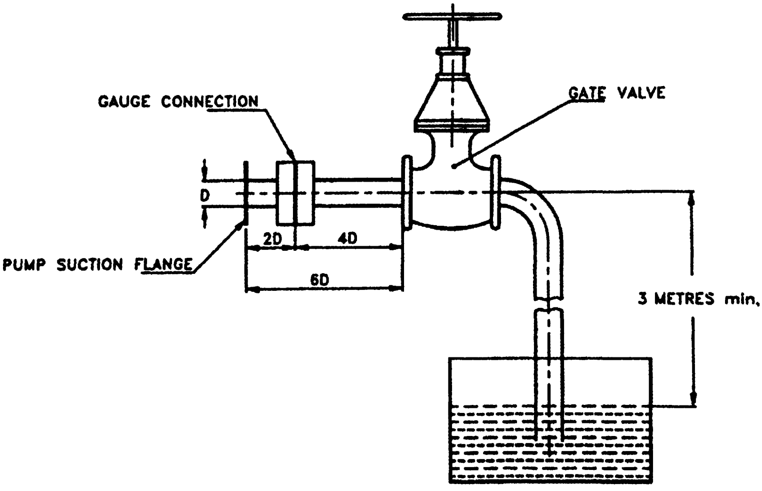


FIG. 5 TEST SET-UP

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This Indian Standard has been developed from Doc: No. : HMD 20 (0379).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 323 01 31, 323 33 75, 323 94 02

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:		Telephone
Central	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	323 76 17, 323 38 41
Eastern	1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola CALCUTTA 700054	337 84 99, 337 85 61 337 86 26, 337 91 20
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Printed at Dee Kay Printers, New Delhi, India

AMENDMENT NO. 1 MAY 2006
TO
IS 8418 : 1999 PUMPS — CENTRIFUGAL SELF PRIMING — SPECIFICATION

(First Revision)

(*Page* 1, *clause* 4, *Notes* 1 *and* 2) — Delete Note 1 and renumber 'Note 2' as 'Note 1'.

(MED 20)

Reprography Unit, BIS, New Delhi, India